

Metal Industry Indicators

Indicators of Domestic Primary Metals, Steel, Aluminum, and Copper Activity

May 2002

The primary metals leading index moved down in April, however, its recent trend has been upward, signaling increased growth in U.S. metals activity. The leading index of metal prices increased sharply in March, suggesting that some metal prices could increase in the coming months.

The **primary metals leading index** fell 0.8% in April, down to 130.4 from a revised 131.4 in March. That marks only the second decrease in the leading index in the past 14 months. The index's 6-month smoothed growth rate slowed to 4.3% from a revised 6.7% in March. The 6-month smoothed growth rate is a compound annual rate that measures the near-term trend. Normally, a growth rate above +1.0% signals an upward trend for future growth in metals activity, and a rate below -1.0% indicates a downward trend.

Only four of the leading index's eight components were available in time to compute the April index. Three of those components moved down, led by a decrease in average weekly hours in primary metals establishments. The Institute for Supply Management's PMI, an index of manufacturing activity, and the stock price component also moved lower. However, all three of these components were easing off of relatively high levels in March. In contrast, the fourth available component, the JOC-ECRI metals price index growth rate, increased to a 2-year high in April.

The size of the March increase in the leading index was revised much lower with the addition of the four components that were not available last month. Three of those components declined in March, and one component, the growth rate of the inflation-adjusted M2 money supply, posted one of its largest drops on record. Still, the growth rate of the primary metals leading index continues to point to an upturn in U.S. primary metals industry activity in the coming months.

The **primary metals coincident index**, a measure of current industry activity, is turning up. The coincident index moved up 1.9% in March, which is only its third increase in the past 21 months and its strongest 1-month increase since 1987. In fact, all five of the metal industry coincident indexes increased in March, the first time that has happened in 31 months.

The **steel leading index** dipped 0.4% in March, the latest month for which it is available, slipping to 112.3 from a revised 112.7 in

February. The index's 6-month smoothed growth rate slowed to 3.0% from a revised 4.5% in February. Although only two of the leading index's nine components, the growth rate of the inflation-adjusted M2 money supply and the index of new housing permits, moved down in March, they registered relatively large decreases. The only strong positive contribution was from the length of the average workweek in steel mills. Despite the March drop in the steel leading index, its growth rate continues to suggest increased domestic steel industry activity in the months ahead.

The **aluminum mill products leading index** fell 1.6% in March, down to 172.4 from a revised 175.2 in February. The index's 6-month smoothed growth rate dropped to 4.1% from 8.6% in February. Three of the index's seven components, the growth rate of the inflation-adjusted M2 money supply, construction contracts for commercial and industrial buildings, and the building permits index, moved down sharply in March. Nevertheless, the growth rate of the leading index continues to point to increased growth in domestic aluminum mill products activity in the near term.

The **primary aluminum leading index** was unchanged in March from a revised 84.8 in February, while the index's 6-month smoothed growth rate moved up to -0.4% from a revised -0.7% in February. The only decline in March among the leading index's six components was a 1.2-hour reduction in the length of the average workweek in primary aluminum establishments. The largest positive contribution to the leading index came from the S&P stock price index for aluminum companies. The growth rate of the primary aluminum leading index has been hovering around zero, which does not provide a clear signal of a recovery in U.S. primary aluminum activity. (Tables and charts for the primary aluminum indexes are in a separate file.)

The **copper leading index** surged 0.9% in March to 119.4 from a revised 118.3 in February, and its 6-month smoothed growth

rate rose to 7.7% from 6.2% in February. Five of the index's six components increased in March, with average weekly overtime hours in copper rolling, drawing, and extruding establishments providing the largest positive contribution to the net increase in the leading index, as was the case in February. The strength in the copper leading index over the past 5 months signals the possibility of increased U.S. copper industry activity in the months ahead.

Metals Price Leading Index at 3-Year High

The **metals price leading index** rose 1.4% in March to 111.3, a 3-year high for this index, up from a revised 109.8 in February. Meanwhile, the index's 6-month smoothed growth rate moved up to 9.3% from a revised 8.0% in February.

Only three of the leading index's four components were available in time to compute the March index value, and all three increased. The growth rate of the index measuring the trade-weighted aver-

age exchange value of other major currencies against the U.S. dollar posted the largest positive contribution in March. The yield spread between the U.S. 10-year Treasury Note and the federal funds rate also registered a strong gain. The growth rate of the inflation-adjusted value of new orders for U.S. nonferrous metal products recorded a smaller gain. The fourth index component, the growth rate of the Economic Cycle Research Institute's 17-Country Long Leading Index, is available only through February when it moved down for the first time in 5 months.

The growth rate of the inflation-adjusted value of inventories of U.S. nonferrous metal products, which typically moves inversely with metal prices, fell to -13.7% in March from a revised -10.7% in February. That is the lowest growth rate for this indicator in 14 years.

The growth rates of the leading index of metal prices and inventories of nonferrous metal products both continue to point to the possibility of increased growth for some metal prices in the months ahead.

Table 1.
Leading Index of Metal Prices and Growth Rates of the Nonferrous Metals Price Index, Inventories of Nonferrous Metal Products, and Selected Metal Prices

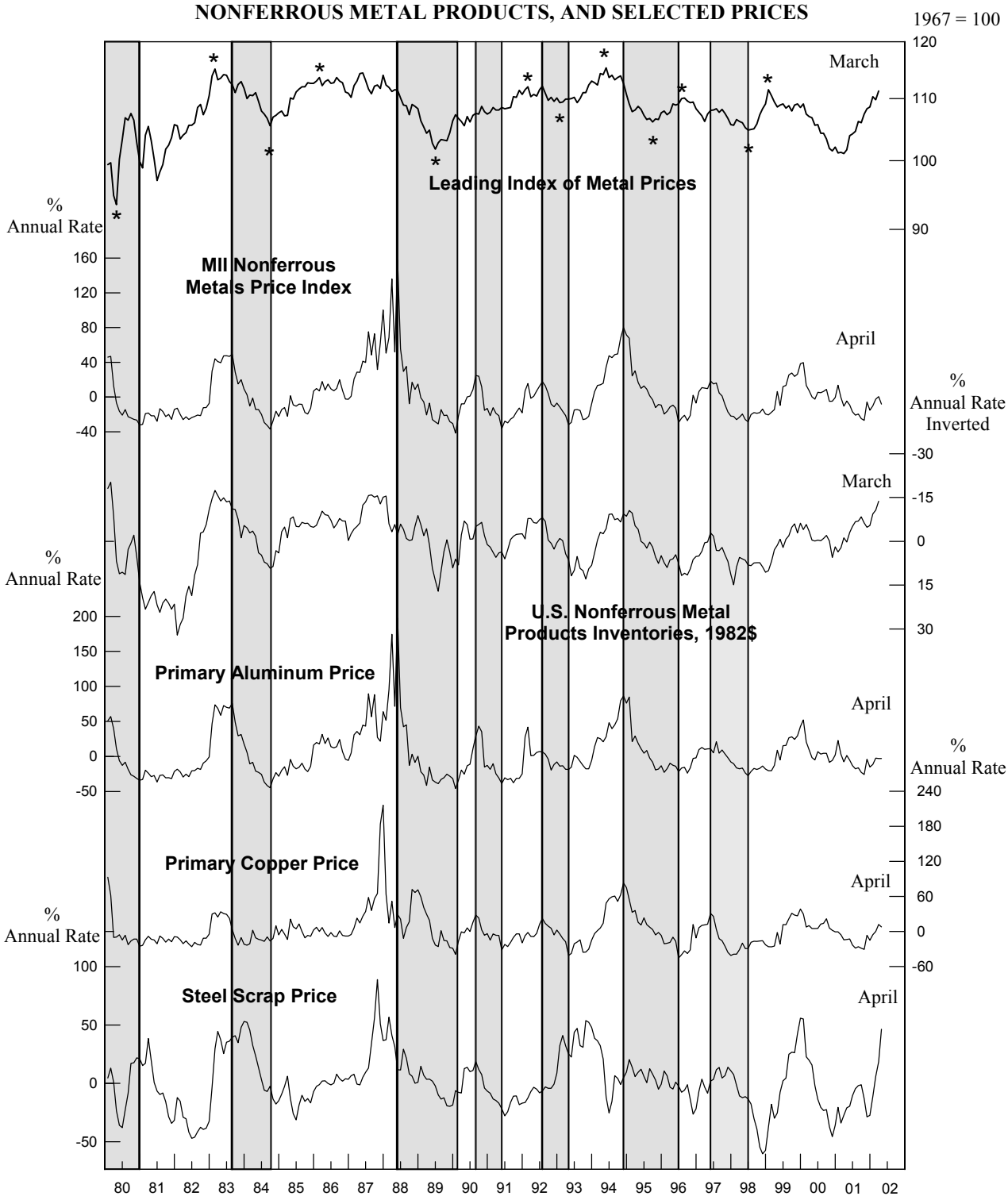
	Leading Index of Metal Prices (1967=100)	Six-Month Smoothed Growth Rates				
		MII Nonferrous Metals Price Index	U.S. Nonferrous Metal Products Inventories (1982\$)	Primary Aluminum	Primary Copper	Steel Scrap
2001						
March	101.1r	-10.5	-1.2	-7.8	-14.4	-27.2
April	101.7	-4.5	0.2	1.5	-13.8	-21.0
May	103.9r	-9.0	-3.0	-5.3	-12.8	-19.5
June	104.2r	-17.0	-5.1	-13.1	-23.3	-10.6
July	104.6r	-20.9	-6.7	-17.7	-28.5	-4.5
August	106.2r	-19.4	-6.9	-16.2	-26.1	-2.0
September	106.0r	-24.7	-8.4	-22.7	-28.7	-1.2
October	107.4r	-26.8	-6.3	-25.7	-30.8	-13.2
November	108.3r	-5.8	-4.8r	-4.1	-6.5	-28.7
December	108.6r	-15.0	-5.4	-15.1	-15.1	-27.4
2002						
January	110.3r	-10.2	-9.4	-11.3	-5.8	-11.3
February	109.8r	-2.5	-10.7r	-2.5	0.0	6.0
March	111.3	0.5	-13.7	-3.0	12.0	-18.5
April	NA	-0.8	NA	-2.9	7.7	46.4

NA: Not available r: Revised

Note: The components of the Leading Index of Metal Prices are the spread between the U.S. 10-year Treasury Note and the federal funds rate, and the 6-month smoothed growth rates of the deflated value of new orders for nonferrous metal products, the Economic Cycle Research Institute's 17-Country Long Leading Index, and the reciprocal of the trade-weighted average exchange value of the U.S. dollar against other major currencies. The Metal Industry Indicators (MII) Nonferrous Metals Price Index measures changes in end-of-the-month prices for primary aluminum, copper, lead, and zinc traded on the London Metal Exchange (LME). The steel scrap price used is the price of No. 1 heavy melting. Inventories consist of the deflated value of finished goods, work in progress, and raw materials for U.S.-produced nonferrous metal products (NAICS 3313, 3314, & 335929). Six-month smoothed growth rates are based on the ratio of the current month's index or price to its average over the preceding 12 months, expressed at a compound annual rate.

Sources: U.S. Geological Survey (USGS); American Metal Market (AMM); the London Metal Exchange (LME); U.S. Census Bureau; the Economic Cycle Research Institute, Inc. (ECRI); and Federal Reserve Board.

**CHART 1.
LEADING INDEX OF METAL PRICES AND GROWTH RATES
OF NONFERROUS METALS PRICE INDEX, INVENTORIES OF
NONFERROUS METAL PRODUCTS, AND SELECTED PRICES**



Shaded areas are downturns in the nonferrous metals price index growth rate. Asterisks (*) are peaks and troughs in the economic activity reflected by the leading index of metal prices. Scale for nonferrous metal products inventories is inverted.

Table 2.
The Primary Metals Industry Indexes and Growth Rates

	Leading Index		Coincident Index	
	(1977 = 100)	Growth Rate	(1977 = 100)	Growth Rate
2001				
May	126.7r	0.5	109.8	-6.2
June	127.2r	1.6r	109.0	-6.7
July	127.2r	1.7r	109.0	-5.7
August	127.5r	2.1	108.0	-6.2
September	127.7	2.5	106.6	-7.4
October	123.6r	-3.6	105.8	-7.5
November	125.0	-1.3	103.1	-10.8
December	127.3r	2.1r	102.4r	-10.5r
2002				
January	129.0r	4.3r	103.3r	-7.8r
February	130.3r	5.9r	102.6r	-8.0r
March	131.4r	6.7r	104.6	-3.5
April	130.4	4.3	NA	NA

NA: Not available r: Revised

Note: Growth rates are expressed as compound annual rates based on the ratio of the current month's index to the average index during the preceding 12 months.

Table 3.
The Contribution of Each Primary Metals Index Component to the Percent Change in the Index from the Previous Month

Leading Index	March	April
1. Average weekly hours, primary metals (SIC 33)	1.2r	-0.7
2. Weighted S&P stock price index, machinery, construction and farm and industrial (December 30, 1994=100)	0.7r	-0.4
3. Ratio of price to unit labor cost (SIC 33)	-0.2	NA
4. JOC-ECRI metals price index growth rate	0.4r	0.6
5. New orders, primary metal products, (NAICS 331 & 335929) 1982\$	0.0	NA
6. Index of new private housing units authorized by permit	-0.4	NA
7. Growth rate of U.S. M2 money supply, 1996\$	-1.0	NA
8. PMI	0.1r	-0.4
Trend adjustment	0.0	0.0
Percent change (except for rounding differences)	0.8r	-0.9
Coincident Index	February	March
1. Industrial production index, primary metals (SIC 33)	0.2	0.2
2. Total employee hours, primary metals (SIC 33)	-0.3	1.2
3. Value of shipments, primary metals products, (NAICS 331 & 335929) 1982\$	-0.8	0.4
Trend adjustment	0.1	0.1
Percent change (except for rounding differences)	-0.8r	1.9

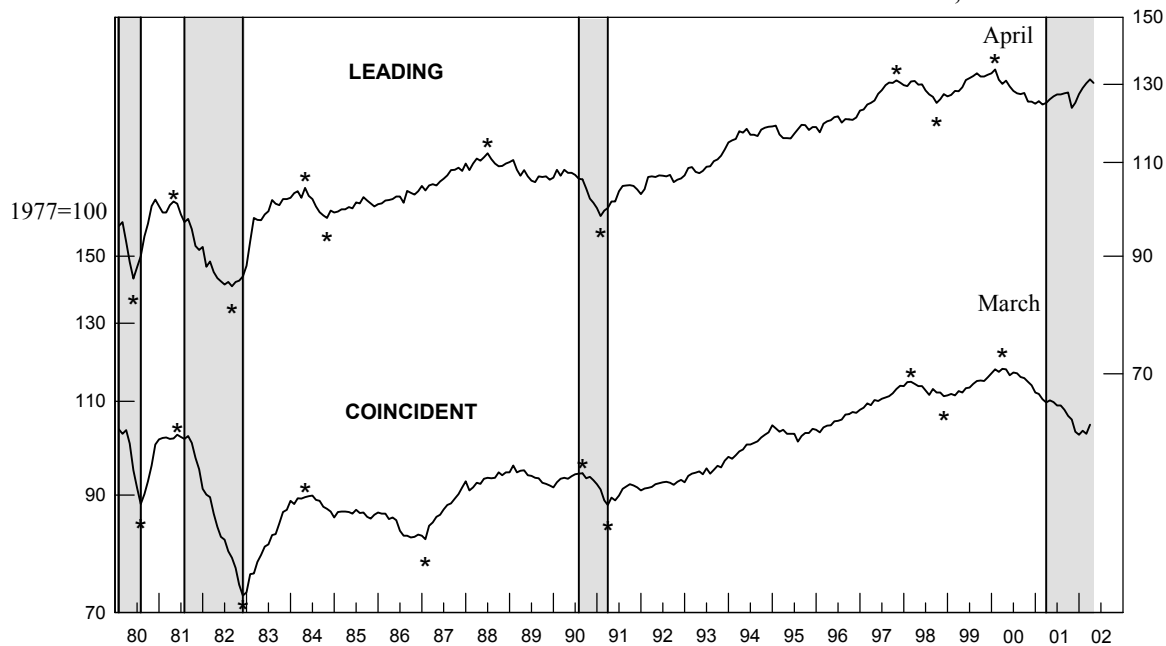
Sources: Leading: 1, Bureau of Labor Statistics; 2, Standard & Poor's and U.S. Geological Survey; 3, U.S. Geological Survey; 4, Journal of Commerce and Economic Cycle Research Institute, Inc.; 5, U.S. Census Bureau and U.S. Geological Survey; 6, U.S. Census Bureau and U.S. Geological Survey; 7, Federal Reserve Board, Conference Board, and U.S. Geological Survey; and 8, Institute for Supply Management. Coincident: 1, Federal Reserve Board; 2, Bureau of Labor Statistics and U.S. Geological Survey; 3, U.S. Census Bureau and U.S. Geological Survey. All series are seasonally adjusted, except 2, 3, and 4 of the leading index.

NA: Not available r: Revised

Note: A component's contribution, shown in Tables 3, 5, 7, and 9, measures its effect, in percentage points, on the percent change in the index. Each month, the sum of the contributions plus the trend adjustment equals (except for rounding differences) the index's percent change from the previous month.

CHART 2.

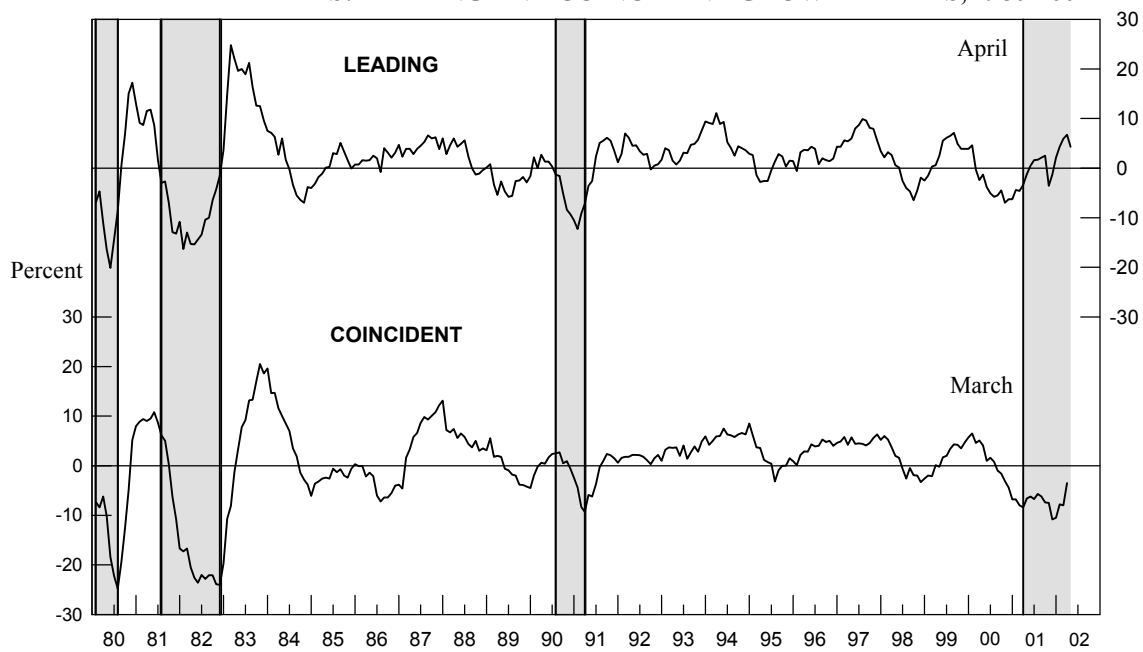
PRIMARY METALS: LEADING AND COINCIDENT INDEXES, 1980-2002 1977=100



Shaded areas are business cycle recessions. Asterisks (*) signify peaks (the end of an expansion) and troughs (the end of a downturn) in the economic activity reflected by the indexes.

CHART 3.

PRIMARY METALS: LEADING AND COINCIDENT GROWTH RATES, 1980-2002 Percent



Shaded areas are business cycle recessions.

The growth rates are expressed as compound annual rates based on the ratio of the current month's index to its average level during the preceding 12 months.

Table 4.
The Steel Industry Indexes and Growth Rates

	Leading Index		Coincident Index	
	(1977 = 100)	Growth Rate	(1977 = 100)	Growth Rate
2001				
April	108.7	0.8	99.3	-4.4
May	109.6	2.9r	99.7	-2.9
June	110.6r	4.8r	99.1	-3.4
July	110.2r	3.9r	98.9	-3.0
August	111.9	6.7r	98.4	-3.3
September	112.5	7.3r	98.4	-2.6
October	109.6r	1.6	97.5	-3.6
November	109.8r	1.5r	95.7	-6.2
December	111.7	4.3	94.1	-8.3
2002				
January	111.1	2.5	95.0	-5.9
February	112.7r	4.5r	94.8	-5.7
March	112.3	3.0	95.6	-3.4

r: Revised

Note: Growth rates are expressed as compound annual rates based on the ratio of the current month's index to the average index during the preceding 12 months.

Table 5.
The Contribution of Each Steel Index Component to the Percent Change in the Index from the Previous Month

Leading Index	February	March
1. Average weekly hours, blast furnaces and basic steel products (SIC 331)	0.2	0.7
2. New orders, iron and steel mills (NAICS 3311 & 3312), 1982\$	0.0r	0.0
3. Shipments of household appliances, 1982\$	-0.2	0.0
4. S&P stock price index, steel companies	0.2	0.1
5. Retail sales of U.S. passenger cars and light trucks (units)	0.3	0.1
6. Growth rate of the price of steel scrap (#1 heavy melting, \$/ton)	0.4	0.1
7. Index of new private housing units authorized by permit	0.1	-0.4
8. Growth rate of U.S. M2 money supply, 1996\$	-0.2	-0.9
9. PMI	0.6	0.1
Trend adjustment	0.0	0.0
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Percent change (except for rounding differences)	1.4r	-0.2
Coincident Index		
1. Industrial production index, basic steel and mill products (SIC 331)	0.3	-0.1
2. Value of shipments, iron and steel mills (NAICS 3311 & 3312), 1982\$	-0.7	0.2
3. Total employee hours, blast furnaces and basic steel products (SIC 331)	0.0	0.7
Trend adjustment	0.1	0.1
	<hr/>	<hr/>
Percent change (except for rounding differences)	-0.3	0.9

Sources: Leading: 1, Bureau of Labor Statistics; 2, U.S. Census Bureau and U.S. Geological Survey; 3, U.S. Census Bureau and U.S. Geological Survey; 4, Standard & Poor's; 5, U.S. Bureau of Economic Analysis and American Automobile Manufacturers Association; 6, Journal of Commerce and U.S. Geological Survey; 7, U.S. Census Bureau and U.S. Geological Survey; 8, Federal Reserve Board, Conference Board, and U.S. Geological Survey; and 9, Institute for Supply Management. Coincident: 1, Federal Reserve Board; 2, U.S. Census Bureau and U.S. Geological Survey; 3, Bureau of Labor Statistics and U.S. Geological Survey. All series are seasonally adjusted, except 4 and 6 of the leading index.

r: Revised

CHART 4.
STEEL: LEADING AND COINCIDENT INDEXES, 1980-2002

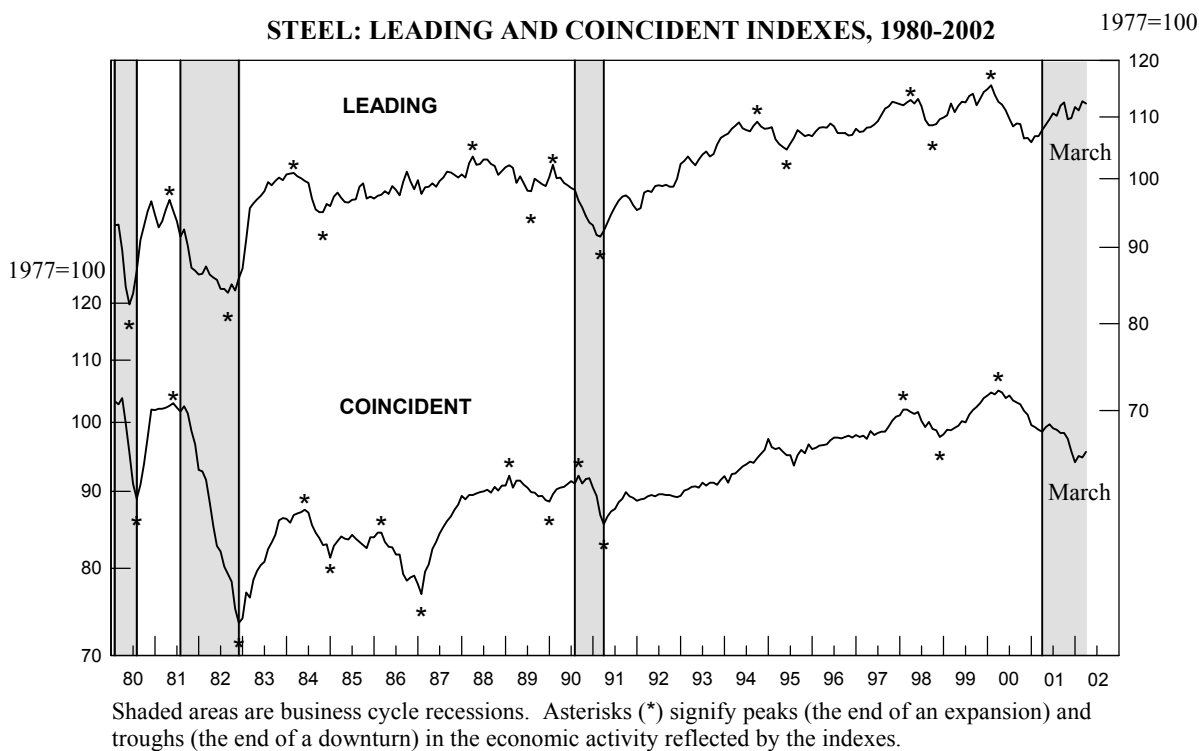


CHART 5.
STEEL: LEADING AND COINCIDENT GROWTH RATES, 1980-2002

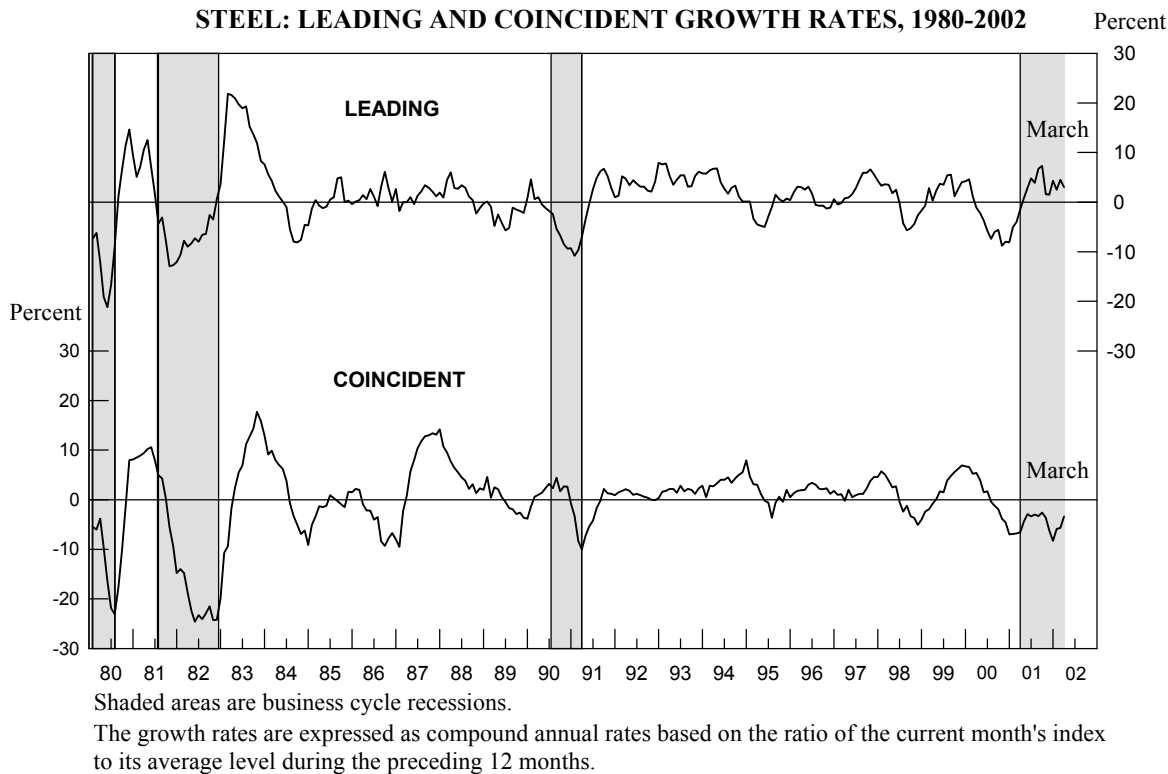


Table 6.
The Aluminum Mill Products Industry Indexes and Growth Rates

	Leading Index		Coincident Index	
	(1977 = 100)	Growth Rate	(1977 = 100)	Growth Rate
2001				
April	164.7	7.6	148.0	7.0
May	163.6r	5.8r	145.9	3.7
June	167.0r	9.1r	143.9	0.9
July	167.5r	8.6r	144.5	1.6
August	167.4r	7.1	142.4	-1.1
September	172.9r	12.7r	145.2	2.6
October	170.3r	8.2	143.8	0.3
November	170.9r	7.4	142.0	-2.3
December	171.3r	6.4r	142.6	-1.7
2002				
January	170.6r	4.4r	144.1r	0.2r
February	175.2r	8.6	145.1r	1.5r
March	172.4	4.1	145.9	2.4

r: Revised

Note: Growth rates are expressed as compound annual rates based on the ratio of the current month's index to the average index during the preceding 12 months.

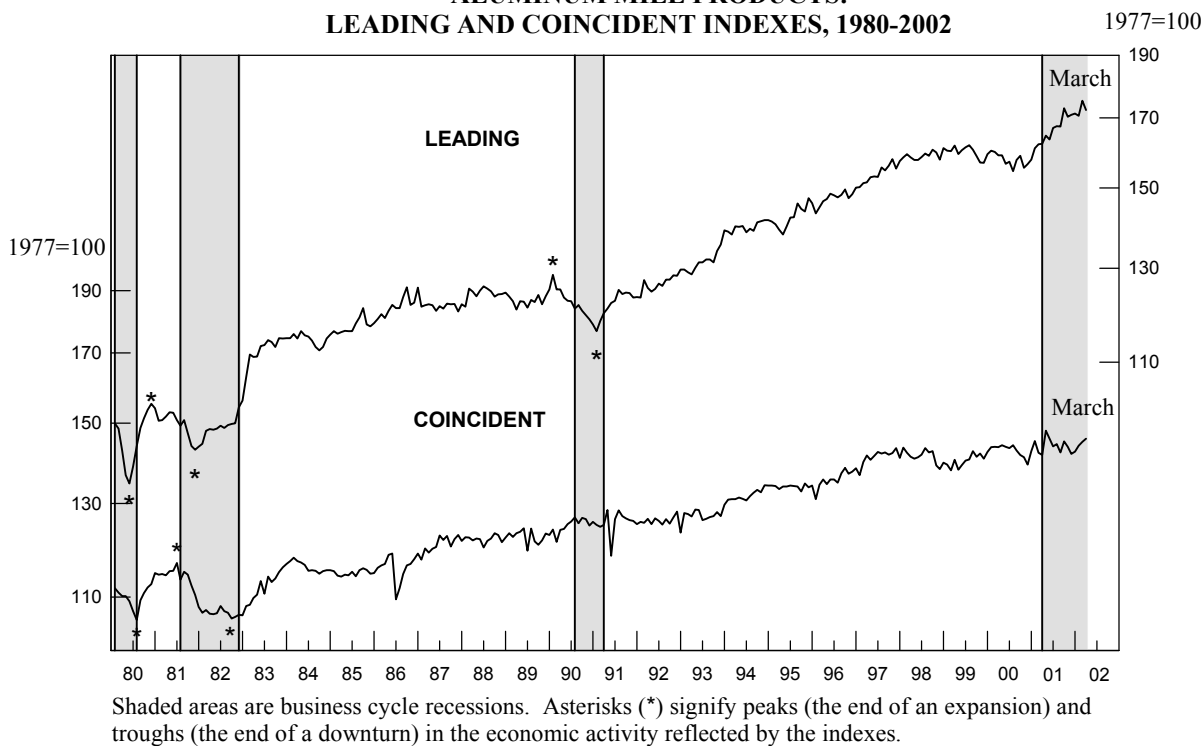
Table 7.
The Contribution of Each Aluminum Mill Products Index Component to the Percent Change in the Index from the Previous Month

Leading Index	February	March
1. Average weekly hours, aluminum sheet, plate, and foil (SIC 3353)	0.6	0.1
2. Index of new private housing units authorized by permit	0.2	-0.5
3. Retail sales of U.S. passenger cars and light trucks (units)	0.4	0.1
4. Construction contracts, commercial and industrial (square feet)	0.5	-0.9
5. Net new orders for aluminum mill products (pounds)	0.4	0.4
6. Growth rate of U.S. M2 money supply, 1996\$	-0.3	-1.2
7. PMI	0.7	0.1
Trend adjustment	0.2	0.2
Percent change (except for rounding differences)	2.7r	-1.7
Coincident Index		
1. Industrial production index, aluminum sheet, plate, and foil (SIC 3353)	-0.2r	0.2
2. Total employee hours, aluminum sheet, plate, and foil (SIC 3353)	0.7	0.3
Trend adjustment	0.2	0.2
Percent change (except for rounding differences)	0.7r	0.7

Sources: Leading: 1, Bureau of Labor Statistics; 2, U.S. Census Bureau and U.S. Geological Survey; 3, U.S. Bureau of Economic Analysis and American Automobile Manufacturers Association; 4, F.W. Dodge, Division of McGraw-Hill Information Systems Company; 5, The Aluminum Association, Inc. and U.S. Geological Survey; 6, Federal Reserve Board, Conference Board, and U.S. Geological Survey; 7, Institute for Supply Management. Coincident: 1, Federal Reserve Board; 2, Bureau of Labor Statistics and U.S. Geological Survey. All series are seasonally adjusted.

r: Revised

**CHART 6.
ALUMINUM MILL PRODUCTS:
LEADING AND COINCIDENT INDEXES, 1980-2002**



**CHART 7.
ALUMINUM MILL PRODUCTS:
LEADING AND COINCIDENT GROWTH RATES, 1980-2002**

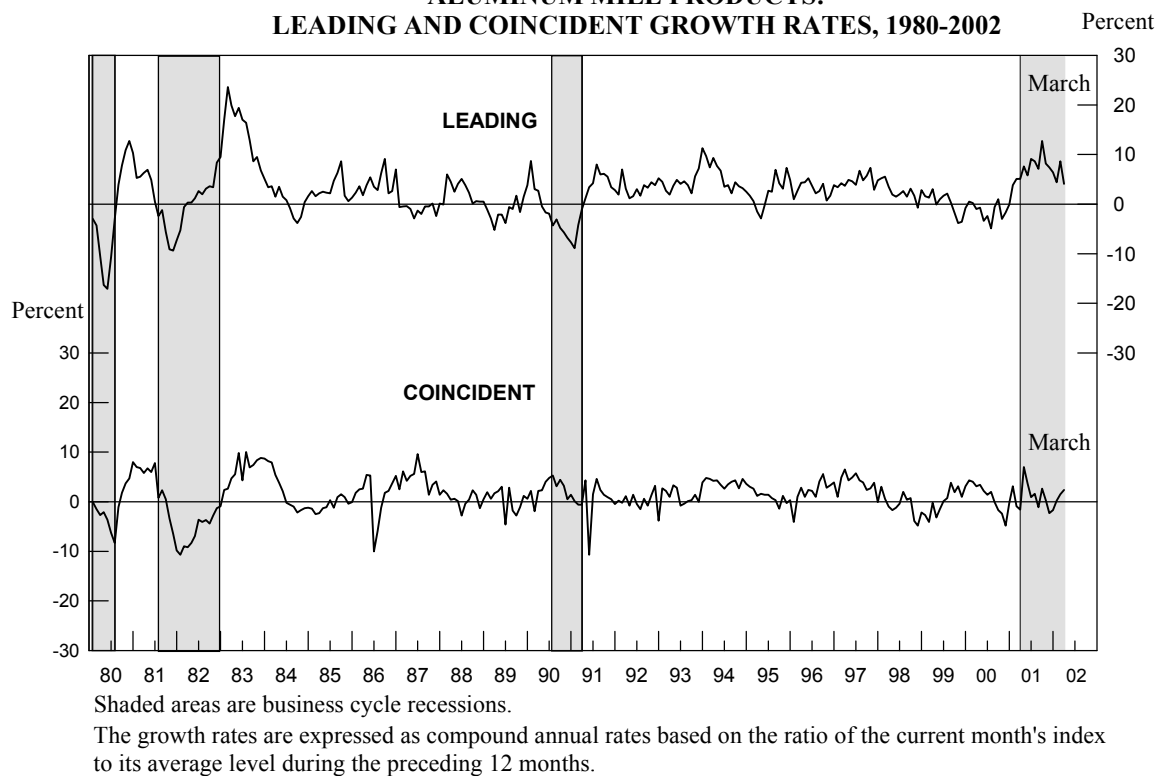


Table 8.
The Copper Industry Indexes and Growth Rates

	Leading Index		Coincident Index	
	(1977 = 100)	Growth Rate	(1977 = 100)	Growth Rate
2001				
April	112.3	-5.2	122.5	-1.1
May	114.9	-0.4	123.6	0.5
June	114.4	-0.9	123.0	-0.3
July	115.1	0.5	121.7	-2.1
August	115.6	1.5	123.8	1.2
September	112.7	-3.0	122.7	-0.4
October	113.0	-2.2	123.7	1.2
November	114.4	0.2	122.9	-0.1
December	116.0	2.7	124.5r	2.5r
2002				
January	117.4	4.9	123.0r	-0.4r
February	118.3r	6.2	122.2r	-2.0
March	119.4	7.7	123.4	0.4

r: Revised

Note: Growth rates are expressed as compound annual rates based on the ratio of the current month's index to the average index during the preceding 12 months.

Table 9.
The Contribution of Each Copper Index Component to the Percent Change in the Index from the Previous Month

Leading Index	February	March
1. Average weekly overtime hours, rolling, drawing, and extruding of copper (SIC 3351)	0.6	0.5
2. New orders, nonferrous metal products, (NAICS 3313, 3314, & 335929) 1982\$	-0.2	0.1
3. S&P stock price index, building products companies	0.2	0.4
4. LME spot price of primary copper	0.1	0.3
5. Index of new private housing units authorized by permit	0.2	-0.6
6. Spread between the U.S. 10-year Treasury Note and the federal funds rate	-0.1	0.3
Trend adjustment	0.0	0.0
Percent change (except for rounding differences)	0.8	1.0
Coincident Index		
1. Industrial production index, primary smelting and refining of copper (SIC 3331)	-0.1r	-0.2
2. Total employee hours, rolling, drawing, and extruding of copper (SIC 3351)	-0.3	0.8
3. Copper refiners' shipments (short tons)	-0.4	0.3
Trend adjustment	0.1	0.1
Percent change (except for rounding differences)	-0.7r	1.0

Sources: Leading: 1, Bureau of Labor Statistics; 2, U.S. Census Bureau and U.S. Geological Survey; 3, Standard & Poor's; 4, London Metal Exchange; 5, U.S. Census Bureau and U.S. Geological Survey; 6, Federal Reserve Board and U.S. Geological Survey. Coincident: 1, Federal Reserve Board; 2, Bureau of Labor Statistics; 3, American Bureau of Metal Statistics, Inc. and U.S. Geological Survey. All series are seasonally adjusted, except 3, 4, and 6 of the leading index.

r: Revised

CHART 8.
COPPER: LEADING AND COINCIDENT INDEXES, 1980-2002

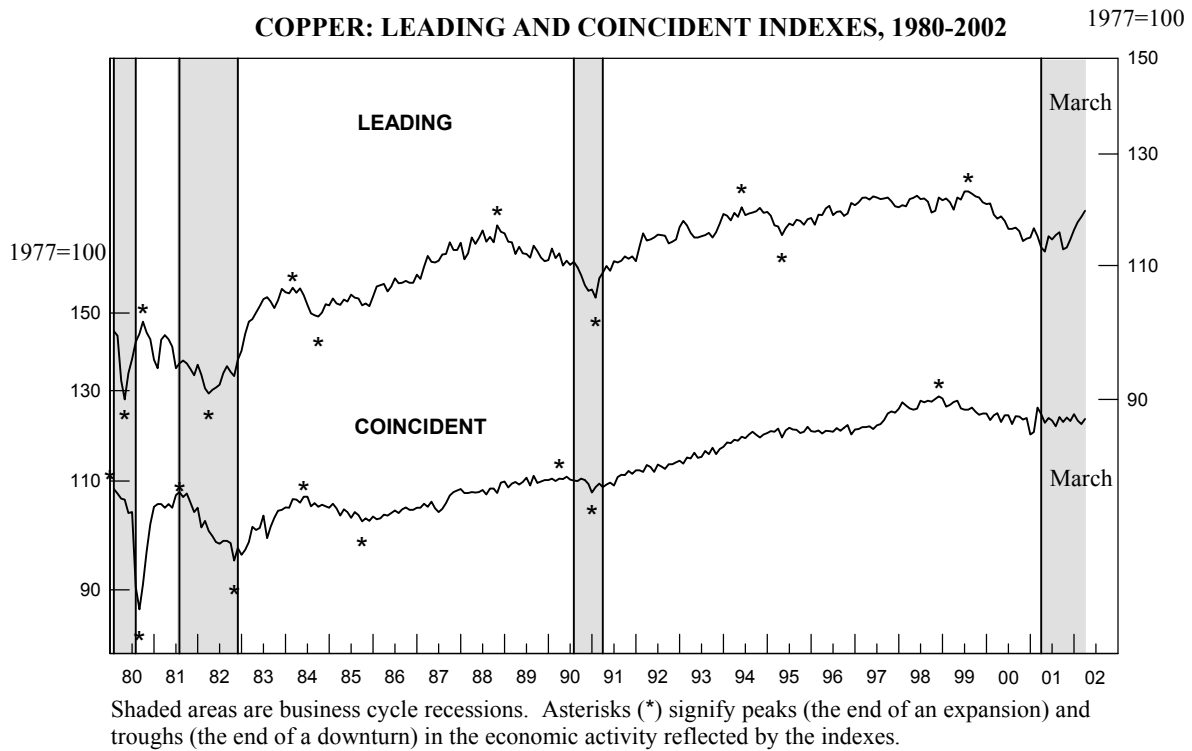
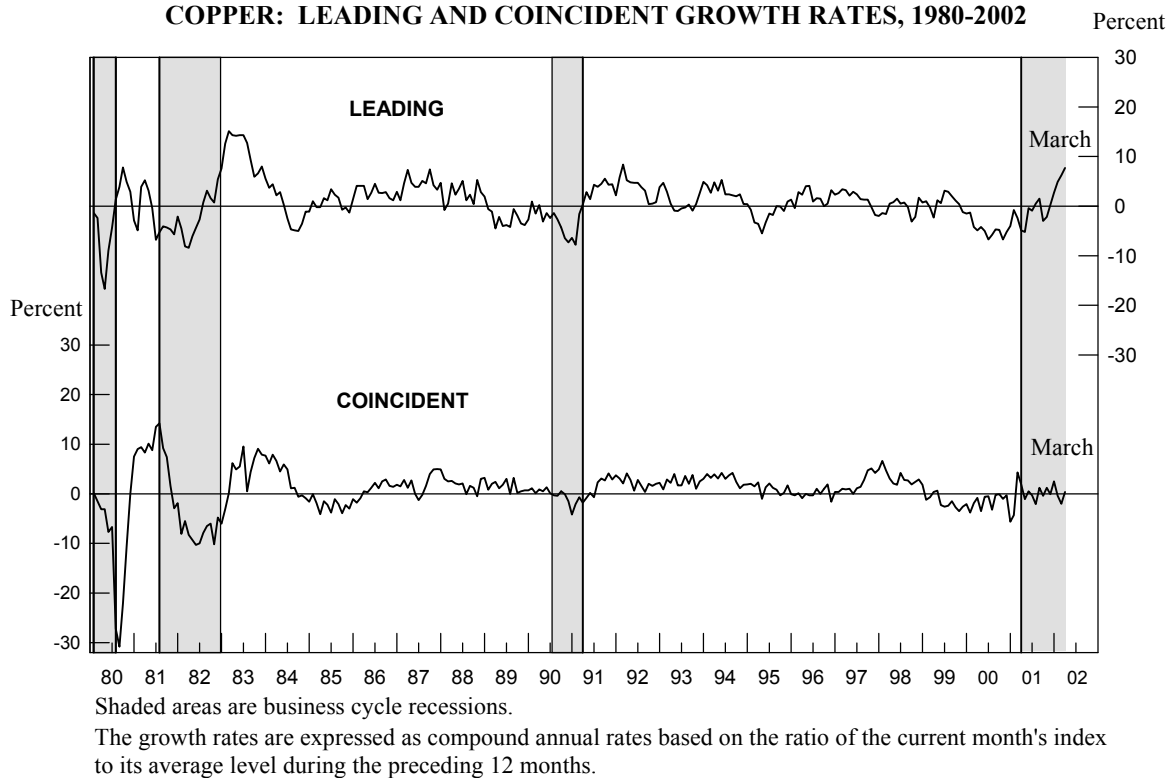


CHART 9.
COPPER: LEADING AND COINCIDENT GROWTH RATES, 1980-2002



Explanation

Each month, the U.S. Geological Survey tracks the effects of the business cycle on five U.S. metal industries by calculating and publishing composite indexes of leading and coincident indicators. Wesley Mitchell and Arthur Burns originated the cyclical-indicators approach for the economy as a whole at the National Bureau of Economic Research in the mid-1930s. Over subsequent decades this approach was developed and refined, mostly at the National Bureau, under the leadership of Geoffrey H. Moore.¹

A business cycle can briefly be described as growth in the level of economic activity followed by a decline succeeded by further growth. These alternating periods of growth and decline do not occur at regular intervals. Composite indexes, however, can help determine when highs and lows in the cycle might occur. A composite index combines cyclical indicators of diverse economic activity into one index, giving decision makers and economists a single measure of how changes in the business cycle are affecting economic activity.

The indicators in the metal industry leading indexes historically give signals several months in advance of major changes in a coincident index, a measure of current metal industry activity. Indicators that make up the leading indexes are, for the most part, measures of anticipations or new commitments to various economic activities that can affect the metal industries in the months ahead.

Composite coincident indexes for the metal industries consist of indicators for production, shipments, and total employee hours worked. As such, the coincident indexes can be regarded as measures of the economic health of the metal industries.

The metal industry coincident indexes reflect industry activity classified by the U.S. Standard Industrial Classification (SIC) and the North American Industry Classification System (NAICS). Of the five metal industries, primary metals (NAICS 331) is the broadest, containing 25 different metal processing industries. Steel, aluminum, and copper are specific industries within the primary metals group.

The SIC was the main vehicle used by the U.S. Government and others in reporting industry economic statistics throughout most of the last century. Starting with the 1997 U.S. Economic Census, the U.S. Government began using the NAICS, which classifies economic data for industries in Canada, Mexico, and the United States. In general, metal industry indexes starting in 1997 begin to reflect the NAICS classification, while indexes for earlier years follow the SIC. Hence, composite indexes from 1997 forward are not entirely consistent with those of earlier years.

The largest change to primary metals because of the NAICS deals with other communication and energy wire manufacturing (NAICS 335929). Under NAICS, this manufacturing has been removed from primary metals and added to electrical equipment, appliance, and component manufacturing. Because monthly shipments and new orders for this wire are not available, the USGS is estimating their values from 1997 onward and adding them to the appropriate metal industry indicators and indexes to maintain consistency.

¹**Business Cycle Indicators, A monthly report from The Conference Board** (March 1996).

There are other small changes to the primary metals industry because of the switch to the NAICS. Coke oven activity not done by steel mills, for example, is removed and alumina refining, a part of industrial inorganic chemical manufacturing under the SIC, is added. Since the historic trends of the composite indexes are not affected by these small changes, the USGS is not making specific adjustments to the indexes for them for the periods before and after 1997.

The metal industry leading indexes turn before their respective coincident indexes an average of 8 months for primary metals and 7 months for steel and copper. The average lead time for the primary aluminum leading index is 6 to 8 months, and the average lead time for the aluminum mill products leading index is 6 months.

The leading index of metal prices, also published in the *Metal Industry Indicators*, is designed to signal changes in a composite index of prices for primary aluminum, copper, lead, and zinc traded on the London Metal Exchange. On average, this leading index indicates significant changes in price growth about 8 months in advance.

The growth rate used in the *Metal Industry Indicators* is a 6-month smoothed growth rate at a compound annual rate, calculated from a moving average. Moving averages smooth fluctuations in data over time so that trends can be observed. The 6-month smoothed growth rate is based upon the ratio of the latest monthly value to the preceding 12-month moving average.

$$\left[\left(\frac{\text{current value}}{\text{preceding 12-month moving average}} \right)^{\frac{12}{6.5}} - 1.0 \right] * 100$$

Because the interval between midpoints of the current month and the preceding 12 months is 6.5 months, the ratio is raised to the 12/6.5 power to derive a compound annual rate.

The growth rates measure the near-term industry trends. They, along with other information about the metal industries and the world economy, are the main tools used to determine the outlook of the industries. A 6-month smoothed growth rate above +1.0% usually means increasing growth; a rate below -1.0% usually means declining growth.

The next summary is scheduled for release on the World Wide Web at 10:00 a.m. EDT, Friday, June 21. The address for *Metal Industry Indicators* on the World Wide Web is: <http://minerals.usgs.gov/minerals/pubs/mii/>

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